There was no rain at Rotorua between the 5th and the eruption, but it rained on the 9th at Wairoa and at Ateamuri, on the Waikato.

At Rotorua the slight mud-shower fell in directions from south-east to south-west, but most from the south-east, as ascertained by an examination of the telegraph poles. At Taheke, on Lake Rotoiti, the mud must have fallen with a south-south-east wind. At Galatea, eighteen miles east-south-east from Rotomahana, no mud fell; but the scoria was thicker on the north-west than on the south-east side of the houses: evidently no strong wind was blowing.

The night of the 9th was calm and fine. During the earlier portion of the eruption there was a slight south-westerly wind at Wairoa, which increased to a strong gale at 3 a.m. At Rotorua there was a slight south-easterly wind up to 4 a.m., when the south-westerly gale reached there from Wairoa. At Taheke, on Lake Rotoiti, the wind changed to south-west at 9 a.m., but there was no gale. At Napier a southerly gale commenced at 4 a.m.; at Gisborne, in Poverty Bay, a south-westerly gale was blowing; at Waiapu a strong north-westerly wind was blowing from 3.15 a.m. to 4.30 a.m., when it changed to the south-west. At the East Cape there was a strong southerly gale. It appears therefore that the south-westerly gale at Wairoa had no direct connection with the eruption, for it commenced about the same time all over the east coast from Napier to the East Cape.

I was surprised to find that the eruption had caused no great atmospheric disturbance, except in its immediate neighbourhood, and that there was no evidence at all of any indrawing currents. The reason for this, no doubt, is that the area over the openings which was violently disturbed is small, so that equilibrium was restored at very short distances around. For this reason a volcanic eruption has none of the effects of a cyclone. The eruption was, as usual, the cause of much electrical disturbance, but this did not affect the weather. F. W. HUTTON

A FEW OF OUR WEATHER TERMS

A RECENT skirmish in the *Times*, on certain words in common use among English meteorologists, and prevalent in our weather reports, suggests that a little overhauling of these and similar terms may be from time to time desirable. In a branch of knowledge which, simultaneously with its growth, becomes more and more popular, new terms expressive of new ideas should not only be accurately descriptive of facts, but should be adapted to popular imagination.

If we cannot have such terms as "helix" and "ant-helix," the Meteorological Department cannot be on safer ground than in their adoption of the terms "cyclone" and "cyclonic," "anticyclone" and "anticyclonic"; these words being precisely antithetical, and expressive of phenomena which are the opposites of each other in almost all their characteristics. To both of these words, however, objections have been raised, and these objections have been somewhat inconsistently based on different reasons. The word cyclone has been objected to because it terrifies our women; but its equivalent, "revolver," would produce at least as alarming an effect. They would soon, however, get accustomed to the use of either. The most unscientific people will quickly understand that when the laws which govern a particular kind of atmospheric circulation have once been proved to be identical, whether that circulation be violent, moderate, or feeble, it becomes desirable to have a single term descriptive of such a circulation. Such nouns as "hurricane," "storm," &c., can be employed, if we please, to denote that the disturbance is of a violent or severe character; while we have plenty of adjectives, strong or mild, to be employed at discretion. Perhaps this will be still more fully realised when the public understands that, in any particular instance, the circulating winds may vary between the most violent and the lightest during the progress of the disturbance. As Mr. Abercromby clearly states it: "The same cyclone may develop the energy of a hurricane soon after its birth in the West Indies, and, after a long and stormy life in its passage across the Atlantic, die surrounded by gentle summer winds on the rocky coasts of Norway." The original use of the term "cyclone" was almost limited to the phenomenon in its acutest stage; and, owing partly to this fact, meteorologists have been disposed to apply the expressions "cyclonic system" and "cyclonic disturbance," &c., to the gentler instances or stages of this kind of circulation, rather than the word "cyclone" itself; but the latter word might now be used without hesitation, for it is most true that "a progressive science uses words provisionally to express provisional ideas, and as the ideas increase in clearness and precision" (and, we may add, in extension) "the word has to take on new meanings."

The term "anticyclone" has been recently objected to as possessing absolutely no significance, an objection which is not in itself worthy of discussion in these pages. This objection is, however, probably founded on one of a more serious nature, viz. that anticyclones are merely interspaces between cyclones. Such interspaces do, of course, exist, and they occasionally travel on without undergoing any very rapid change of form in company with the cyclones. But the interspaces between circles or ovals are not circular or oval; and further (as is more important to observe, and as has long ago been shown to be true) the anticyclone proper has characteristics of its own which distinguish it from these interspaces: its movements are often slow, or it is stationary for a considerable period, while in both hemispheres it has the power of deflecting the course of the cyclones moving in its vicinity more or less towards the right, except in particular positions.

Now let us look at the word "depression" and the ideas associated with it. It would probably be an impossible as well as an undesirable task to get rid of this term altogether, but for this reason it becomes all the more necessary clearly to define its meaning. Originally it signifies a lowering of the surface of the barometric column due to a diminution of pressure on the surface of the mercury in the cistern. It is equally well employed to designate a "taking off" or diminution of atmospheric pressure. In any case, it might be employed to designate such a diminution of pressure as takes place during the lessening or the passing off of an anticyclone. But by common usage it has come to be practically equivalent to cyclone, the only difference being (1) that it naturally refers to the diminution of pressure within the cyclone, and not the circulating winds, and (2) that it can be usefully applied to areas diverging considerably from the circular form. The ease with which the idea of a saucer-shaped hollow in the ocean of atmosphere is entertained, and the associations of the word "gradient" (a word valuable, suggestive, but figurative—a word for which I can find no substitute, unless it be a coined one), have certainly led to some misconceptions. Over the front or ascensional part of a cyclone, atmospheric pressure is greater at the level of four, five, or six miles above the earth's surface than over surrounding regions at the same level. It would be well for our storm-warnings if more people were careful to observe the violent north-westerly upper-current prevailing immediately in front of, and over, the southerly winds which we feel when a cyclonic disturbance is coming upon us from west-south-west. The few who have noticed this cannot fail to be struck by the fact that at the level of the cirrus the pressure must increase with extreme rapidity at the same time that pressure is decreasing at the earth's surface. It is true that in the rear of the disturbance an extension of the great

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polar area of depression in the higher regions of the atmosphere is shown by the movements of the higher clouds. Any one who will be at the trouble to chart out these phenomena will feel that the neat little orographical maps of the atmosphere with which some of our popular writers on weather would present us are exceedingly different from the realities.

The terms "col," ridge," "trough," &c., for a similar reason, while assisting the popular imagination, perhaps assist it in the wrong direction, and I would, though with much deference to better authorities, suggest that such terms as "arm," "band," "belt," "extension," &c., might be employed with a little more safety. To the terms "deep," "depth," "high," "height," might not my own respectable old words, "intense," "intensity," even now be found preferable? and for the word "shallow" the word "slight" in many cases be advantageously substituted? I am aware that in a magazine article or in a weather report some variation of terms and expressions is frequently desirable, but the cover has not yet been fairly drawn; and an abundance of useful words is still available, without recourse being had to terms either borrowed from foreign languages or expressive of incorrect ideas. W. CLEMENT LEY

NOTE ON INSTANTANEOUS SHUTTERS

THE introduction of rapid dry plates having made a general demand for mechanical shutters, a large variety are now offered for sale by the various makers. Many of these shutters are neat and ingenious, but nearly all have a tendency to shake the camera during exposure, and in the only one which I have seen for sale in which this mistake has been avoided the photographic efficiency of the arrangement has been impaired by the opening being made to assume the form of a gradually expanding and contracting hole; the idea being, I am told, that while the opening is small it will act as a stop and secure definition. This, of course, is true to a certain extent—how far, I will inquire presently.

I do not know whether the general theory of mechanical shutters has been discussed, but if it has it is certainly not well known, and perhaps the following remarks, which point out what the photographic efficiency of the various classes of shutters is and their effect on the steadiness of the camera, may be of some use.

Shutters may be divided into two chief classes, viz. those in which the principal moving part consists of a single piece, and those where the moving parts are multiple; the great difference between them being that, while the first class must exert either a force or a couple on the camera during exposure, the second class may be so designed as to exert neither. The first class consists of drop-shutters and revolving disks with an aperture which passes across the lens, and of those shutters where a sliding piece rises and falls or a hinged piece opens and shuts. Of the second class I only know of one as being in the market, though probably many amateurs may, like myself, have made them for their own use. In this shutter two plates, occupying the position of the ordinary stop in the lens, separate and come together again. Each plate has a deep V-shaped notch in it; the apex of each V when the shutter is closed being in the axis of the lens. The opening is therefore a quadrilateral figure which gradually expands and contracts.

The mechanical arrangements of nearly all the shutters, except those belonging to the revolving disk and drop-shutter class, are such as to make the motion of the shutter a simple harmonic function, or nearly so, of the time from the commencement of exposure, while in the drop-shutters and disks the aperture may be taken as moving across the lens with a nearly uniform velocity. This, of course, would not be true if the motion of the parts was quite free under the action of the driving force, but friction enters largely into the account; and even if it did not, no large error will be introduced in calculating the photographic effect of shutters of this class by assuming that velocity of the moving part is uniform during exposure and equal to its mean velocity.

The photographic effect of a shutter is measured by the sum of the products of each element of aperture brought into action by the shutter and the time for which that element acts. This measures the total amount of light which passes through the lens during exposure, but it does not necessarily follow that the light should be uniformly distributed on the sensitive plate. This, indeed, only happens when the shutter is at the optic centre of the combination.

In mathematical notation, if the path of a point in the shutter be along a line x, and if U be the area of the lens expressed in terms of x, and T_x the time for which dU, the element of area exposed in passing from x to $x + dx$, acts, then the photographic effect of the shutter is $\int T_x dU$, taken between the proper limits of x.

The photographic efficiency of a shutter may be taken as the ratio of this quantity to the whole area of the lens, multiplied by the whole time of exposure, or $T'U'$.

The result of integrating the above expression may always be put in the form

$$aT'U',$$

where a is a numerical constant, which therefore expresses the efficiency of the particular shutter considered.

I subjoin a few results showing the efficiency of several different types of shutter:—

	Efficiency
(1) Drop-shutter with circular aperture (uniform velocity)	$a = \cdot 43$
(2) Harmonic opening from one side (x proportional to cos pt)	$a = \cdot 5$
(3) Harmonic opening from centre, the opening being a circular hole of radius ρ (proportional to sin pt)	$a = \cdot 5$
(4)[1] Harmonic opening from centre, the aperture being formed by the edges of two plates which recede from a diameter of the lens and the boundary of the lens (x proportional to sin pt)	$a = \cdot 764$

It will be seen that as far as efficiency goes the drop-shutter is lowest on the list.

The next two have the same efficiency, but while the second has a tendency to shake the camera the third has not. If, instead of assuming that the aperture in this case was circular, we had made it square, as in the shutter before referred to, the efficiency would not have been quite as great as ·5.

No. 4 has the highest efficiency of any, viz. ·764, and differs from the last merely in having no V-shaped notches in the plates which close the aperture, so that the opening begins as a slit instead of a point. Thus by the adoption of the square expanding aperture nearly 40 per cent. of possible efficiency is lost.

The gain in definition caused by the aperture acting as a stop may be estimated by comparing the amount of light (L_1) admitted while the opening is small enough to make the definition good, with the total amount of light admitted (L) minus (L_1), remembering that the greater the aperture up to which the shutter may open without sensibly impairing the definition the less is the possible gain in definition from the use of a stop. Thus, suppose the greatest aperture consistent with good definition to be $\rho^2 \times$ full aperture (R^2). Then the use of a stop of radius ρ can only reduce the radius of the circle of confusion about the image of a point by $\frac{R - \rho}{R}$ times what it would have

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[1] This is the form which I use, but I am not aware of any shutter of the kind being in the market.

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